

**Immersive Collaboration Simulations: Multi-User Virtual
Environments and Augmented Realities**

by

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Simulations:
Multi-User Virtual Environments
and Augmented Realities**

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The Evolution of Education

- **shifts in the knowledge and skills
society values**
- **development of new methods of
teaching and learning**
- **changes in the characteristics of learners**

**emerging information technologies
are reshaping each of these**

The Rapid Advance of Information Technologies

- *Device* (cell phone, HDTV, personal digital assistant)
- *Application* (word processors, intelligent tutoring systems, educational simulations)
- *Medium* (shared virtual environments, interactive television, worldwide web)
- *Infrastructure* (Internet, telephone system, cable and broadcast television, cyberspace)

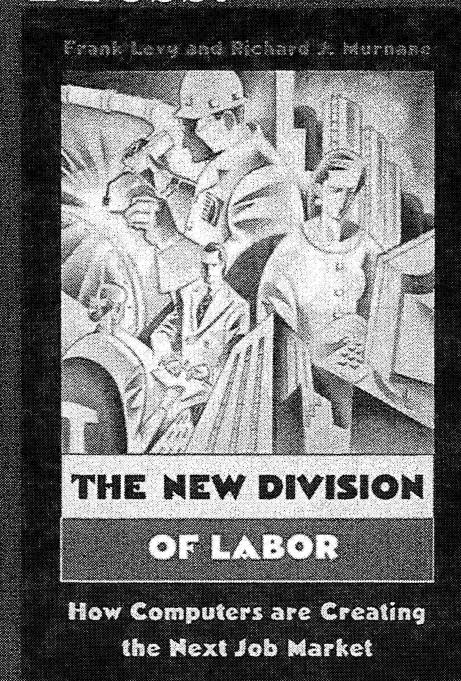
Automation vs. Amplification

Levy, F., & Murnane, R. J. (2004).

The new division of labor: How computers are creating the next job market.

Princeton, NJ: Princeton University Press.

- Expert Decision Making
- Complex Communications



Focus on A Particular Suite of Understandings and Performances

Collaborative Problem Resolution via Mediated Interaction:

- **Problem Finding Before Problem Solving**
- **Comprehension by a Team, Not an Individual**
- **Making Meaning Out of Complexity:**
 - Utilizing sophisticated tools and representations
 - Recognizing and matching patterns
 - Judging the value of alternative formations
 - Communicating to others with differing perspectives

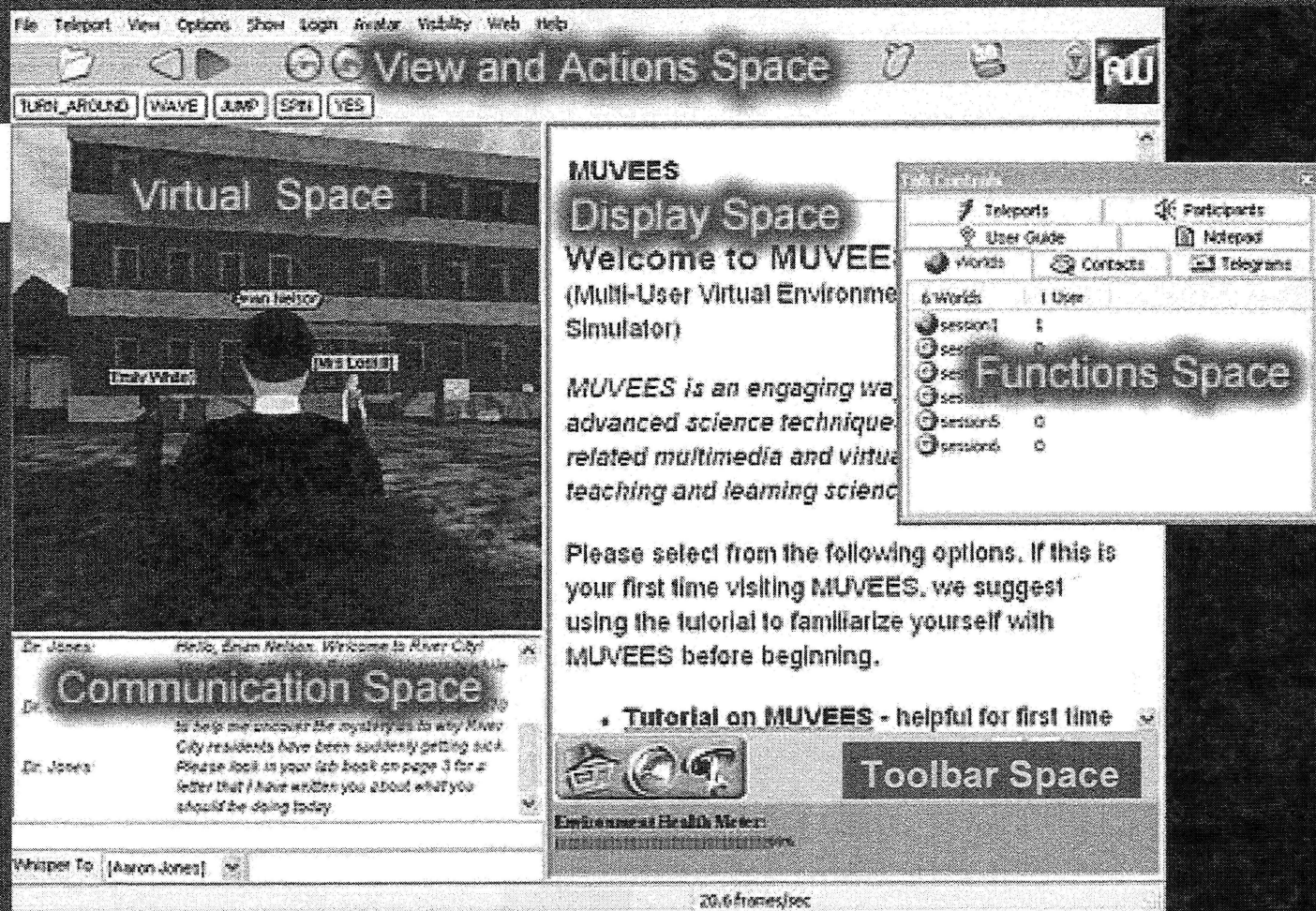
Next Generation Interfaces for “Distributed Learning”

- **World to the Desktop:**
Accessing distant experts and archives for knowledge creation, sharing, and mastery
- **Multi-User Virtual Environments:**
Immersion in virtual contexts with digital artifacts and avatar-based identities
- **Ubiquitous Computing:**
Wearable wireless devices coupled to smart objects for “augmented reality”

What is a MUVE?

- ✓ A representational container that enables multiple simultaneous participants to access virtual spaces configured for learning.
- ✓ A place where learners represent themselves through graphical avatars (persona) to communicate with others' avatars and computer-based agents, as well as to interact with digital artifacts and virtual contexts.
- ✓ A learning experience that provides diverse activities in support of classroom curriculum.

<http://muve.gse.harvard.edu/rivercityproject/>



Situated Learning

- **constellations of architectural, social, organizational, and material vectors that aid in learning culturally based practices**
 - **apprenticeship (the process of moving from novice to expert within a given set of practices)**
 - **legitimate peripheral participation (tacit learning similar to that involved in internships)**
 - **high fidelity is not important unless essential for task (e.g., interpreting photographic images)**

Distributed-Learning Communities

- ✓ Range of participants' skills and interests goes beyond geographic boundaries
- ✓ Asynchronous media enable convenient participation and deeper reflection
- ✓ Emotional and social dimensions intensified by synchronous virtual interchanges
- ✓ Broader range of participants engage in dialogue

Collaborative, Mediated, Situated Immersion

Traditional Inferential Methods

On average, students in the River City treatment scored 2.21 points higher on the post test than students in the control ($t=2.76$, $p<.01$), ($n=358$).

On average, students in the River City treatment scored .2 points higher on the post self-efficacy in general science inquiry section of the affective measure ($t=2.22$, $p<.05$).

On average, students in this sample who saw higher gains in self efficacy in general science inquiry scored higher on the post test. These gains were higher for students in the River City project. ($n=358$)

Yet these results tell us nothing about patterns, behaviors, and processes that lead to inquiry. We are also limited by # of variables we can build into our model.

Evidence of Student Work

- **Assessment data:**
 - Pre-post content
 - Pre-post affective
 - Embedded assessments (formative)
 - Performance assessment (summative)
- **Contextual Data:**
 - Attendance records
 - Demographic data
 - School data
 - Observations
 - Interviews
- **Active Data:**
 - Team chat
 - Notebook entries
 - Tracking of in-world activities:
 - Data gathering strategies
 - Pathways
 - Inquiry processes

Logfiles as Data

Indicates with Timestamps

- **Where students went**
- **With whom they communicated and what they said**
- **What artifacts they activated**
- **What databases they viewed**
- **What data they gathered using virtual scientific instruments**
- **What screenshots and notations they placed in team-based virtual notebooks**
- **What hints they accessed**

Case of Shorty: Session 2

Starting at the periphery.... Participation challenged as “goofing around”; help seeking:

- Shorty: Hype, G3, what do we have to do
- Shorty: Where are you G3?
- Shorty: I found you Hype
- G3: Stop goofing around
- Shorty: I'm not goofing around, G3
- G3: Aaron Nelson said that a horrible cough was going around
- Shorty: So
- Shorty: What do we do
- G3: Doctor Paterson said they can't find a cure yet for the new problem
- Shorty: What page is it on
- Shorty: What else do we do
- Shorty: I cant find you G3

Shorty: Sessions 3 and 4

Distributing the task.... Building Knowledge, Wrestling with complexity:

- G3: I'm going to the University
- Shorty: I'm going to the dump
- G3: Prof. Koch thinks microbes are causing the problem
- G3: Shorty go to the lookout
- Shorty: G3, Emily White said that her cough is bad but Mrs. Pabisky is working in the kitchen and her cough is worse
- Shorty: G3 do you think that's the problem too
- G3: They closed the beach due to the pollution
- Shorty: The river smelled bad

Shorty: Sessions 5 and 6

**Moving towards leadership, providing help,
(taking more pivotal role)**

Shorty: I'm going to the water sampling station in the wealthy homes

Shorty: What are you guys doing?

Shorty: G3 go to the hospital I'm taking water samples

Hype: What do we do?

Shorty: Do the same thing you did on Friday; ask the same people and write down what the said this time

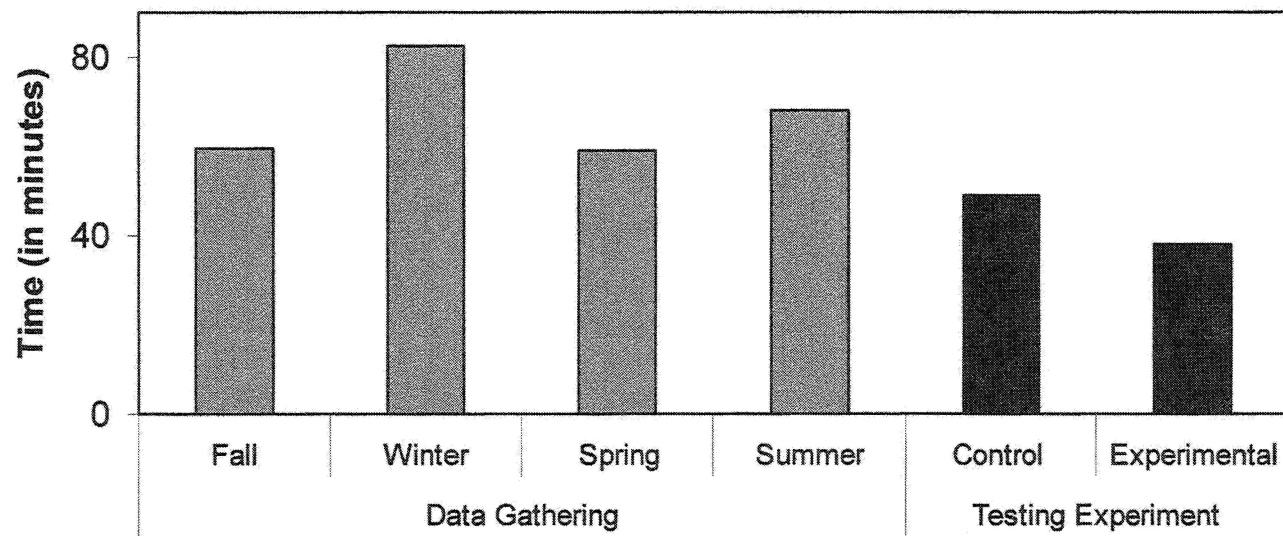
21st Century Research: **Data Analytics**

- **How do we make sense of all this data (too much rather than too little)?**
- **How to cross-reference and synthesize these data to improve student learning?**
- **How do we evaluate whether such environments are effective for learning?**

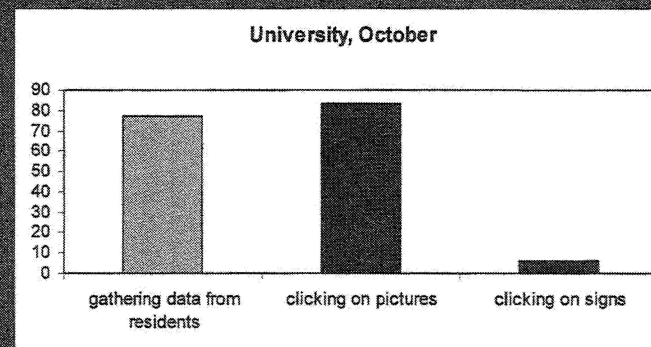
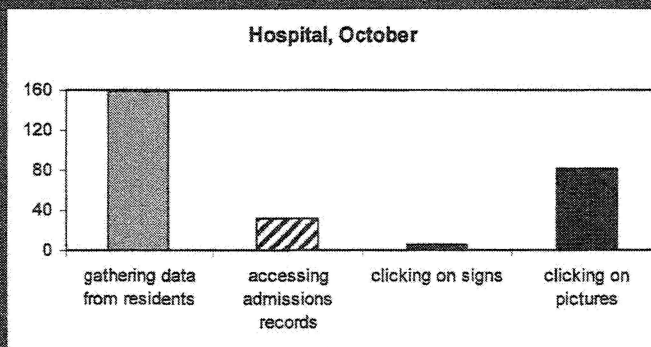
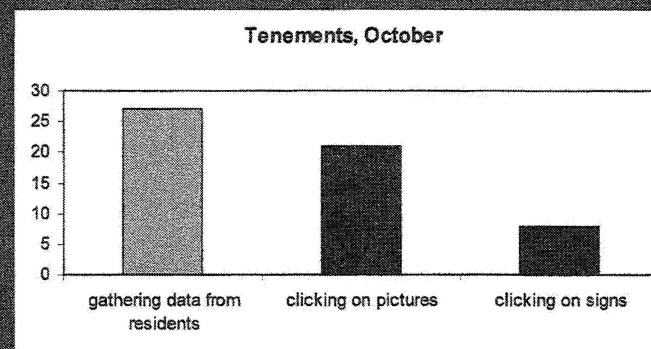
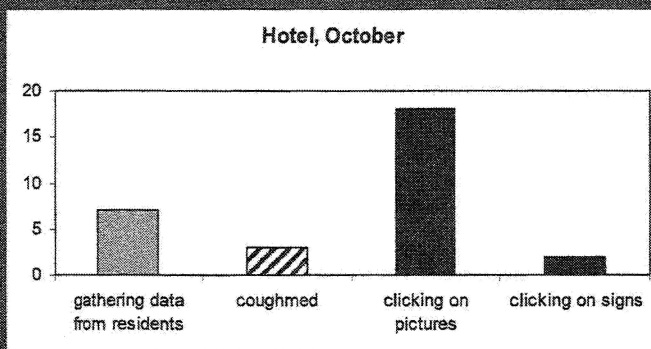
Illustrative Collective

Logfile Analysis:

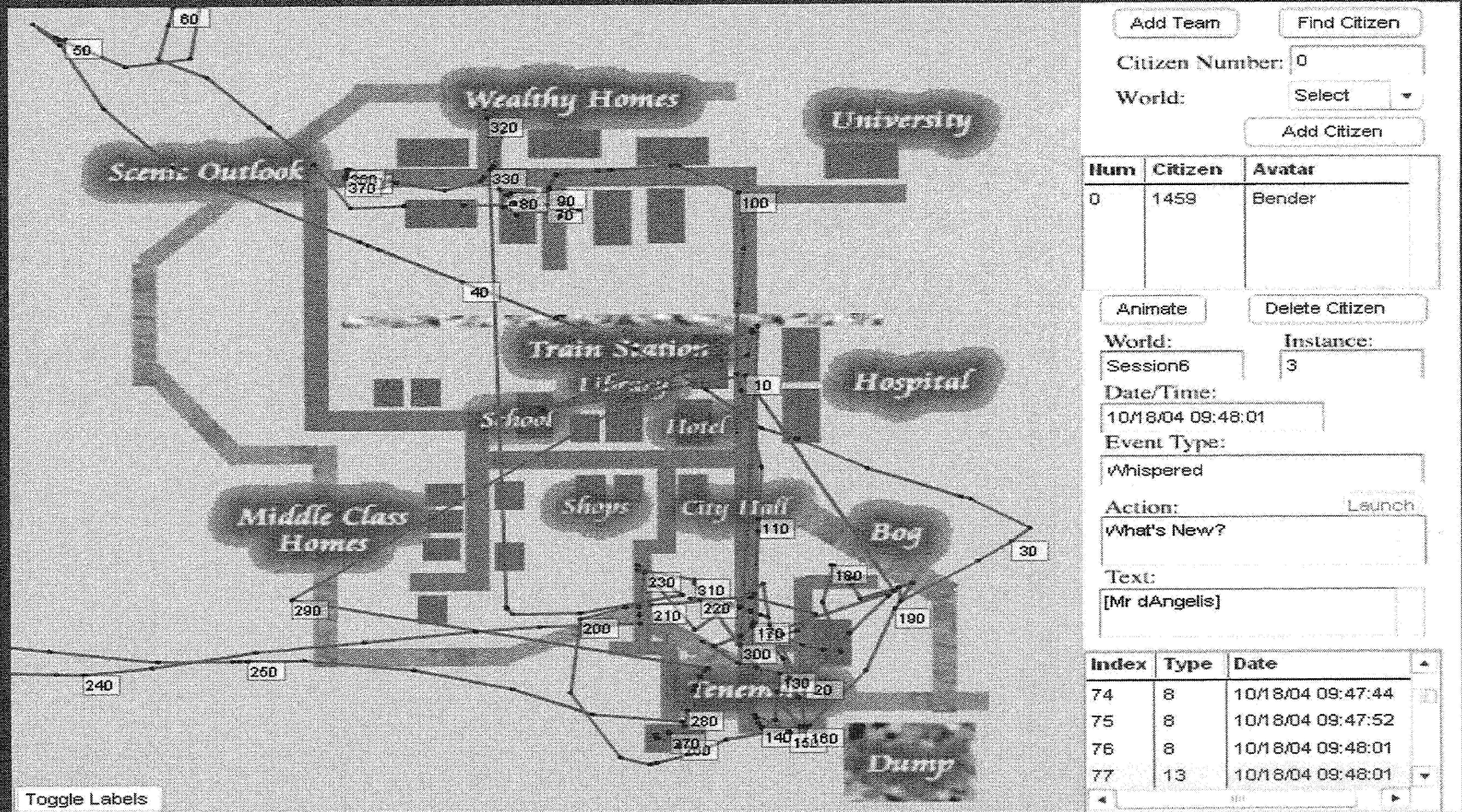
Average Time Spent in River City (n=678)

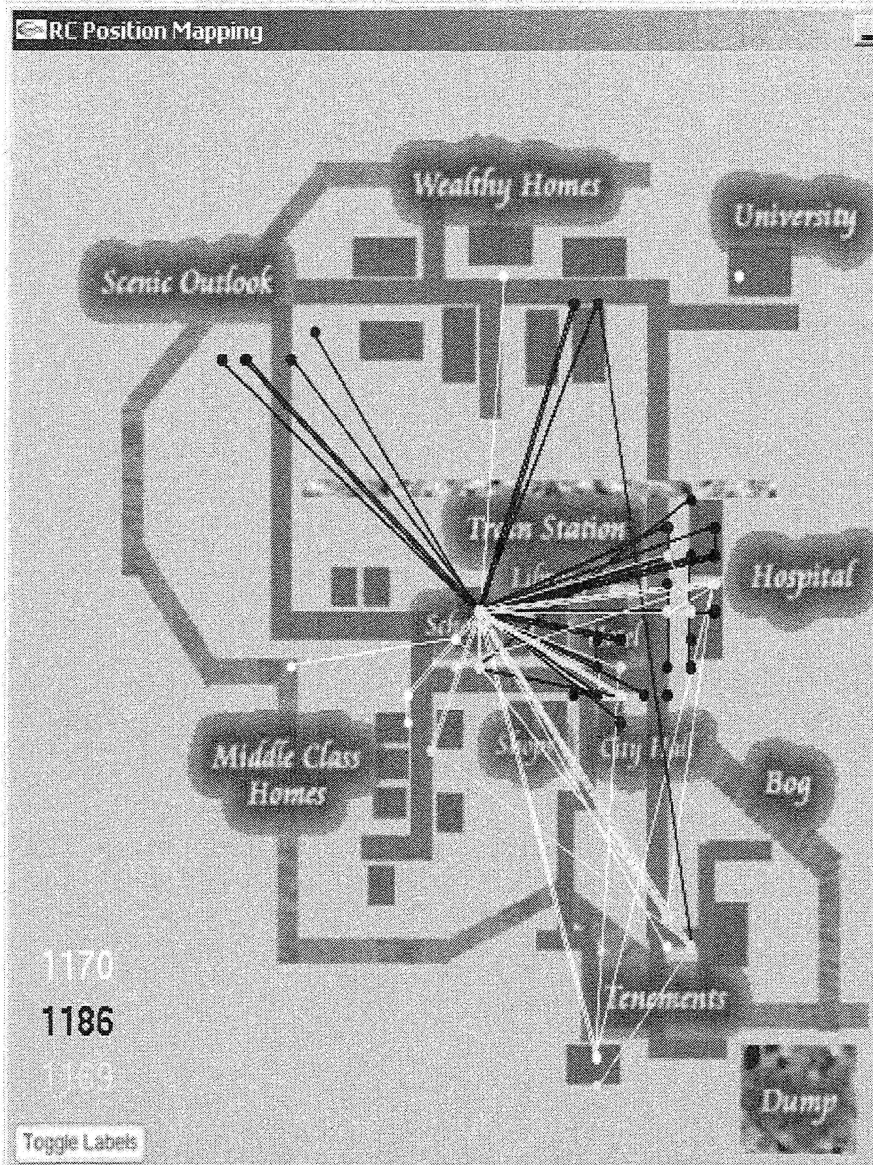


Examples of Activities by Location

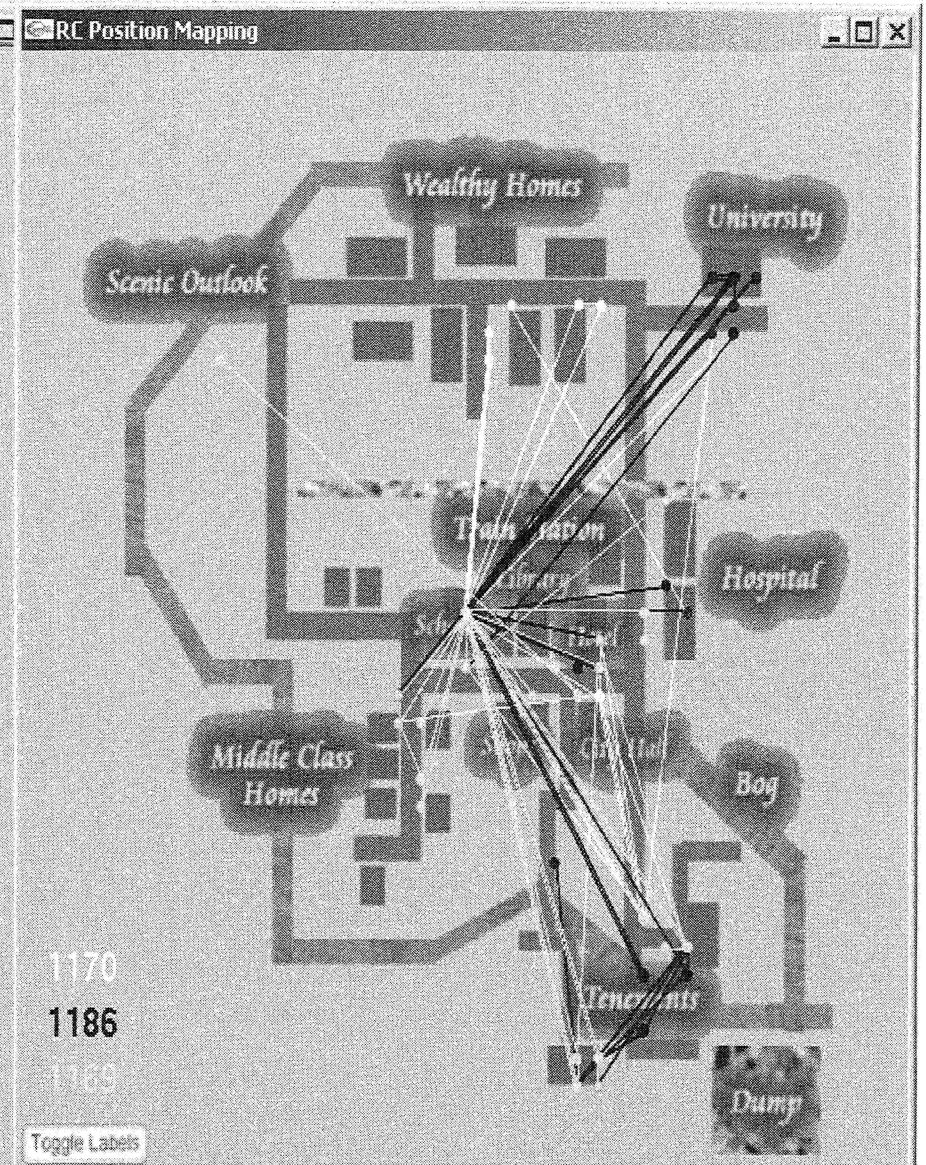


Visualization of Student Activities





Shorty's (1169) Team, Session 2



Shorty's Team, Session 3

Illustrative Collective

Logfile Analysis:

- More female residents (21) than male (13);
4 of 5 resident experts are female
 - Intentional to make environment comfortable for girls
- 96 students with same teacher logged about 3000 conversational gambits in two-week implementation
- Boys and girls talk to male and female residents in equal proportions
- Girls are substantially more active than boys in talking to residents
- Boys' conversations are task-oriented; girls add a social dimension
- Substantial individual variation in information-gathering patterns

Mechanisms for Automated Logfile Analysis

Easy

- How often does a given student talk to a female agent, and is the conversation social or task-oriented?
- What proportion of scientific data in a team's virtual notebook was contributed by a given team member?
- How much time do students spend gathering data?

Less Easy

- What sequence of interactions in the world led to a particular student becoming deeply engaged?

Hard

- Is a particular student developing an increasingly sophisticated pattern of inquiry over time?

Datamining: Next Generation

Educational Analytics

The process of selecting, exploring, and modeling large amounts of data to uncover previously unknown patterns

An iterative learning-based process similar to other knowledge generation processes, such as scientific discovery

Routine in the business world: Decisions around database marketing, credit risk management, and fraud detection are all influenced through predictive modeling

The Promise of Educational Datamining

- **Formative, diagnostic information that provides real-time feedback to teachers**
- **Summative assessments about what each student has mastered, based on authentic performances**
- **Insights about student behavior and learning related to individual characteristics**
- **A better understanding of collaborative problem solving and team learning processes**
- **Insights about the microgenetics of learning by examining patterns and relationships between students' behavioral patterns and learning outcomes**

Potential Insights for Students

Evolution over time of:

- Engagement
- Information-Seeking
 - Sources: context, agents, artifacts, databases, virtual scientific instruments, hints...
- Collaboration, including use of virtual notebook
- Content Mastery
- Inquiry strategies

Potential Insights for Teachers

- **Diagnostic, formative information about individual students**
 - Engagement
 - Level and types of hints accessed
 - Skewed information-gathering patterns
- **Diagnostic, formative information about students collectively**
 - Level of collaboration
 - Degree to which types of hints are needed
 - Degree to which some kinds of information resources are underutilized
 - Patterns of scores on embedded content assessments

“Next Generation” Interfaces for Distributed Learning

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Ubiquitous Computing

- **One-to-one student to tool ratio**
- **Wireless Mobile Devices (WMD) offer approximately 60% of the computing power of laptops of a few years ago at 10% of the cost**
- **Wireless mobile computing – instant on, anytime, everywhere, and in the hand of the user**
- **“Smart objects” and “intelligent contexts” enable animistic environments with distributed cognition**

“Augmented Reality”

Handheld Augmented Reality Project (HARP)

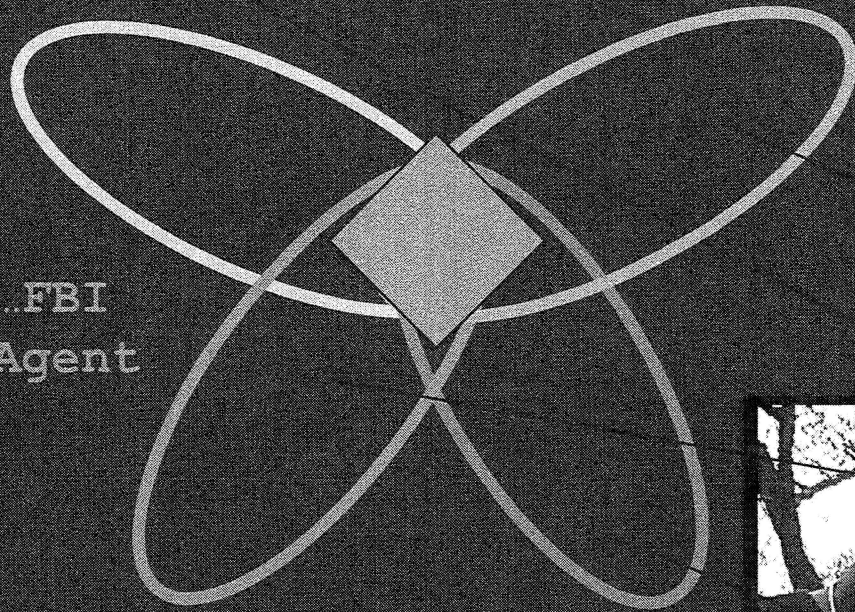


Collaboration & Interdependence

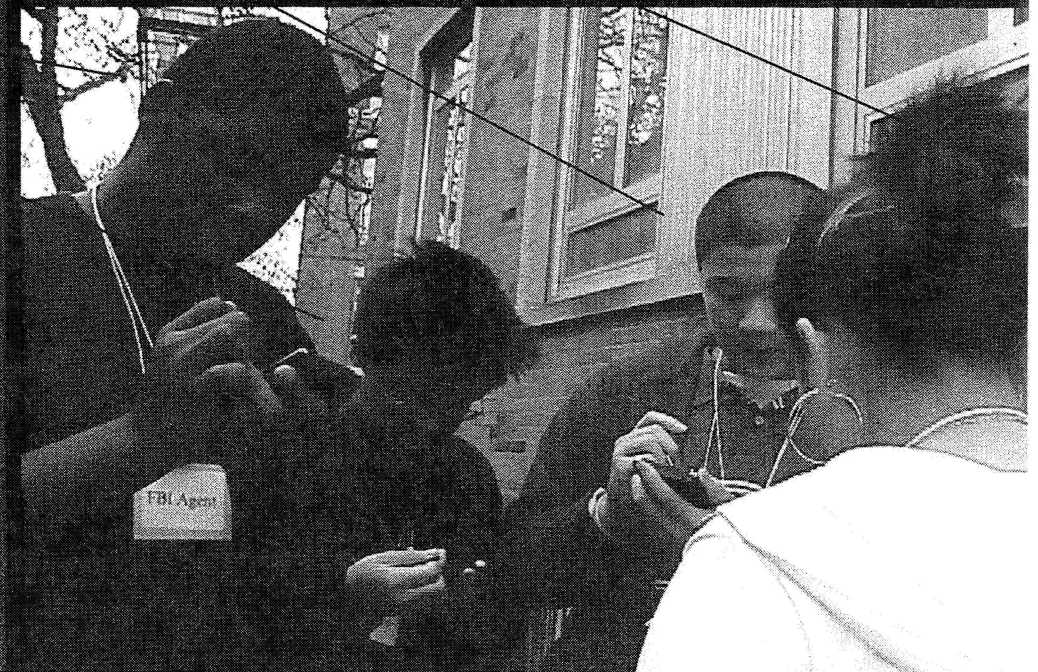
...Chemist

...Linguist

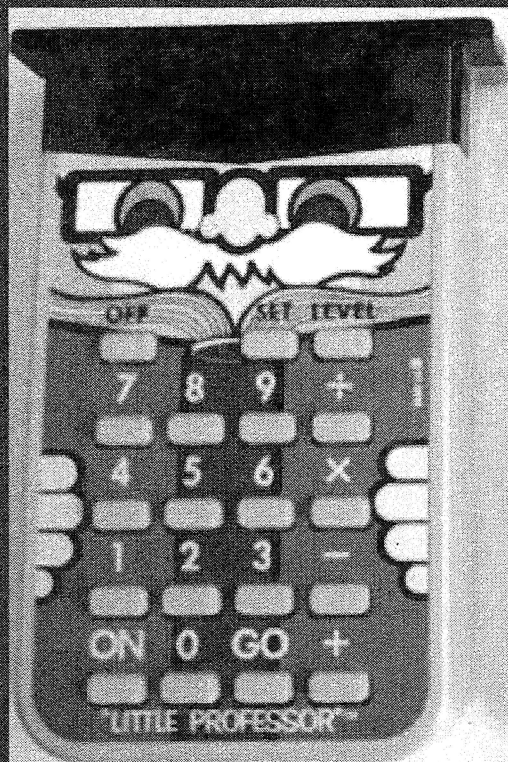
...FBI
Agent



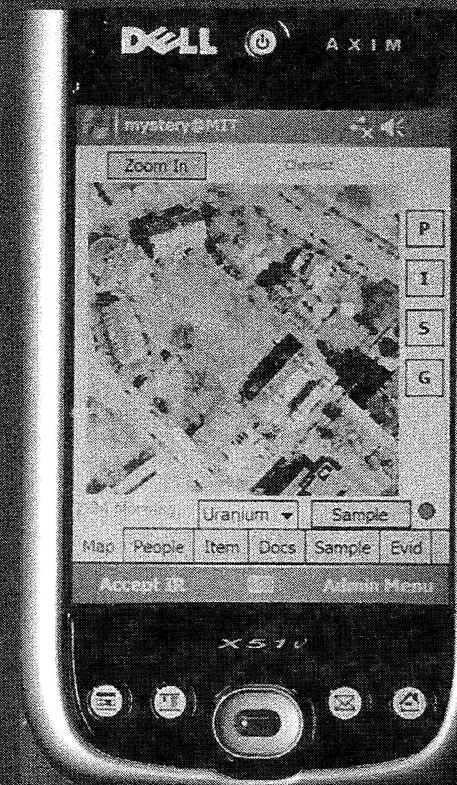
...Computer Expert



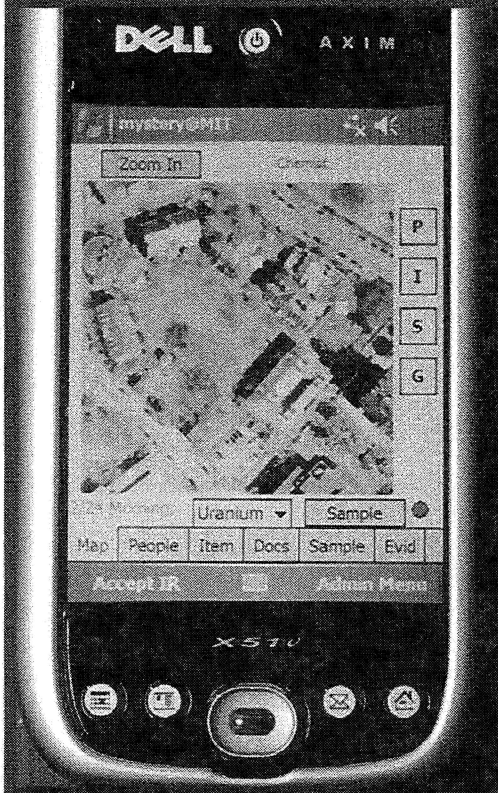
1976



2006



2006



2015



A Different Model of Pedagogy

- Experiences central, rather than information as pre-digested experience (for assimilation or synthesis)
- “Walking the Tightrope” between simplicity and complexity
- Knowledge is situated in a context and distributed across a community (rather than located within an individual: with vs. from)
- Reputation, experiences, and accomplishments as measures of quality (rather than tests, papers)

“Umbrella” for Pedagogies

Assumptions about Learning:

Sleeping ----- **Eating** ----- **Bonding**
simple complex

Jenkin's Framework for New Literacies

- *Play* — experimenting with one's surroundings in problem-solving
- *Performance* — adopting alternative identities for improvisation and discovery
- *Simulation* — interpreting and constructing dynamic models of real-world processes
- *Appropriation* — the ability to meaningfully sample and remix media content
- *Multitasking* — scanning one's environment and shifting focus to salient details
- *Distributed Cognition* — fluently using tools that expand mental capacities
- *Collective Intelligence* — pooling knowledge with others toward a common goal
- *Judgment* — evaluating the reliability and credibility of different information sources
- *Transmedia Navigation* — the ability to follow the flow of stories and information across multiple modalities
- *Networking* — the ability to search for, synthesize, and disseminate information
- *Negotiation* — the ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms

Leu's Characteristics of New Literacies

1. Emerging ICT tools, applications, media, and environments require novel skills, strategies, and dispositions for their effective use.
2. New literacies are central to full economic, civic, and personal participation in a globalized society.
3. New literacies constantly evolve as their defining ICT continuously are renewed through innovation.
4. New literacies are multiple, multimodel, and multifaceted.

Professional Development: Communities of “Unlearning”

- ❖ **Developing fluency in using emerging interactive media**
- ❖ **Complementing presentational instruction with collaborative inquiry-based learning**
- ❖ **Unlearning almost unconscious assumptions and beliefs and values about the nature of teaching, learning, and schooling**

Crucial issue for professional development

Beyond McLuhan

- **Media shape their messages**
- **Media shape their participants**
- **Infrastructures shape civilization**